UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No	0107-0997-3
First Inventor or Application Identifier	Reinhard JOHO
Title	LAMINATED STATOR BODY FOR AN ELECTRICAL MACHINE

U.S. PTO 09/220055 12/23/98

12/23/98 U.S. PTO

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. ■ Fee Transmittal Form (e.g. PTO/SB/17)
(Submit an original and a duplicate for fee processing)

2. ■ Specification — Total Pages: 7

3. ■ Drawing(s) *(35 U.S.C. 113)* — Total Sheets: 1

4. □ Oath or Declaration — Total Pages:
   a. □ Newly executed (original or copy)
   b. □ Copy from a prior application *(37 C.F.R. §1.63(d))*
   (for continuation/divisional with box 15 completed)
   i. □
   DELETION OF INVENTOR(S)
   Signed statement attached deleting inventor(s) named in the prior application, see *37 C.F.R. §1.63(d)(2) and 1.33(b)*

5. □ Incorporation By Reference *(usable if box 4B is checked)*
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4B, is considered to be part of the disclosure of the accompanying application and is hereby incorporated by reference therein

ACCOMPANYING APPLICATION PARTS

6. □ Assignment Papers (cover sheet & document(s))
7. □ 37 C.F.R. §3.73(b) Statement *(when there is an assignee)* □ Power of Attorney
8. □ English Translation Document *(if applicable)*
9. ■ Information Disclosure Statement (IDS)/PTO-1449 ■ Copies of IDS Citations (4)
10. ■ Preliminary Amendment
11. ■ White Advance Serial No. Postcard
12. □ Small Entity Statement(s) □ Statement filed in prior application. Status still proper and desired.
13. ■ Certified Copy of Priority Document(s) **(1)**
(if foreign priority is claimed)
14. ■ Other: **Request for Priority**
List of Inventor's Name & Address
German Search Report
Translation of Category
Statement of Relevancy

15. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below*
□ Continuation □ Divisional □ Continuation-in-part (CIP) of prior application no.:
Prior application information: Examiner: Group Art Unit:

16. Amend the specification by inserting before the first line the sentence:
□ This application is a □ Continuation □ Division □ Continuation-in-part (CIP)
of application Serial No. Filed on
□ This application claims priority of provisional application Serial No. Filed

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Docket No. 0107-0997-3

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTOR(S) Reinhard JOHO et al.

SERIAL NO: New Application

FILING DATE: Herewith

FOR: LAMINATED STATOR BODY FOR AN ELECTRICAL MACHINE

FEE TRANSMITTAL

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

FOR	NUMBER FILED	NUMBER EXTRA	RATE	CALCULATIONS
TOTAL CLAIMS	13 - 20 =	0	× $18 =	$0.00
INDEPENDENT CLAIMS	1 - 3 =	0	× $78 =	$0.00
☐ MULTIPLE DEPENDENT CLAIMS (If applicable)			+ $260 =	$0.00
■ LATE FILING OF DECLARATION			+ $130 =	$130.00
			BASIC FEE	$760.00
			TOTAL OF ABOVE CALCULATIONS	$890.00
☐ REDUCTION BY 50% FOR FILING BY SMALL ENTITY				$0.00
☐ FILING IN NON-ENGLISH LANGUAGE			+ $130 =	$0.00
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Respectfully Submitted,

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Date: 12/23/98

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Docket No. 0107-0997-3

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: Reinhard JOHO et al.

FILING DATE: Herewith

FOR: LAMINATED STATOR BODY FOR AN ELECTRICAL MACHINE

LIST OF INVENTORS' NAMES AND ADDRESSES

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

Listed below are the names and addresses of the inventors for the above-identified patent application.

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Albrecht BOCK	Gorxheimertal, FRANCE

A declaration containing all the necessary information will be submitted at a later date.

Respectfully Submitted,

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Docket No.: 0107-0997-3

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF:	:	
Reinhard JOHO et al.	:	GROUP ART UNIT: Unassigned
SERIAL NO: New Application	:	
FILED: Herewith	:	EXAMINER: Unassigned
FOR: LAMINATED STATOR BODY FOR AN ELECTRICAL MACHINE	:	

PRELIMINARY AMENDMENT

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

Prior to examination on the merits, please amend the above-identified application as follows:

IN THE CLAIMS

Claim 1, line 3, delete "(1)" (both occurrences);

line 4, delete "(2)";

line 5, delete "(1)";

line 6, delete "(3)" (both occurrences).

Claim 2, line 1, delete "(3)";

line 2, delete "(4)".

Claim 3, line 1, delete "or 2";

line 2, delete "(3)" and "(2)".

Claim 5, line 1, delete "or 2";

line 2, delete "(3)" and "(2)".

Claim 7, line 1, change "one of the preceding claims" to --claim 1--;

line 2, delete "(3)".

Please add new Claims 8-13 as follows:

--8. The laminated stator body as claimed in claim 2, wherein the number of notches is twice as great as the number of slots.

9. The laminated stator body as claimed in claim 2, wherein the notches have a width of between 0.5 mm and 1 mm.

10. The laminated stator body as claimed in claim 3, wherein the notches have a width of between 0.5 mm and 1 mm.

11. The laminated stator body as claimed in claim 4, wherein the notches have a width of between 0.5 mm and 1 mm.

12. The laminated stator body as claimed in claim 5, wherein the notches have a width of between 0.5 mm and 1 mm.

13. The laminated stator body as claimed in claim 6, wherein the notches have a width of between 0.5 mm and 1 mm.--

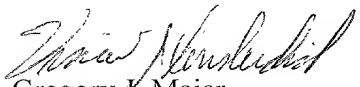
REMARKS

The above amendment corrects the dependency of the claim structure and eliminates multiple dependent claims as well as adds new Claims 8-13. Each of the claims are fully

supported by the specification. No new matter is added. Therefore a full and thorough examination on the merits of the Claims 1-13 is requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



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TITLE OF THE INVENTION

Laminated stator body for an electrical machine

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to the field of electrical machines. It relates to a laminated stator body for a rotating electrical machine as specified in the preamble of claim 1.

Such an electrical machine is disclosed, for example, by "Konstruktion elektrischer Maschinen" ["Construction of electrical machines"], E. Wiedemann and W. Kellenberger, Springer-Verlag, Berlin/Heidelberg, 1967, pages 337 - 339.

Discussion of Background

In rotating alternating-current machines, such as, for example, generators or motors, magnetic fields rotate in operation at the frequency of the rotational speed. These fields attempt to change the laminated stator body into a rotating ellipse in the case of two-pole machines and into a rotating square in the case of four-pole machines. These deformations of the laminated stator body are the cause of magnetic noises and of vibrations of the stator casing. In this case, however, these deformations are also directly related to the geometric proportions of the laminated stator body. Contributory variables are the outside diameter of the laminated stator body and the yoke height of the laminated body. The depth of the slots for accommodating the stator winding, which are distributed over the inner circumference of the bore and are oriented to the longitudinal axis of the machine, also has an effect.

Typical designs of 2-pole generators with their so-called 4-node vibrations of the laminated stator body, which occur under operating conditions, make it necessary for the laminated body to be arranged resiliently in a stator casing. However, the utilization of the resilient arrangement is limited not least by the strength of the stator winding overhangs arranged outside the laminated stator body.

The use of generators as turbomachines in high-voltage networks is especially problematical - and the essence of the present invention is also directed at this problem -, the term high voltage referring here to a far higher voltage than the operating voltages of 20 - 30 kV which are common today. Such high-voltage generators are used in a voltage range of up to 400 kV or higher and are connected directly - that is, without the interconnection of a transformer - to a power

transmission network having a conventional voltage level of, for example, 400 kV. The advantages of a direct network connection lie in particular in the saving of transformers and associated switchgear, including installation space and maintenance cost.

In high-voltage generators, however, a larger number of turns than in conventional machines is a basic precondition. The larger number of turns must therefore be inserted in deeper slots of a laminated stator body. In publication JP 1-126141, the notches are filled with a permeable material, which, however, means that more material is required and thus the costs are higher.

In the case of the yoke height - that is, the distance between the slot root and the outside diameter of the laminated stator body - the dimension, in view of the magnetic flux flowing through, must not fall below a minimum. However, the combination of deep stator slots and yoke heights designed with regard to the flux density leads to operation in the vicinity of the 4-node natural frequency and thus to inadmissible amplitudes at the abovementioned 4-node vibrations. The amplitudes of the vibrations would increase up to an order of magnitude of 150 m, which may lead to the mechanical destruction of the electrical machine. In terms of economical transport, strengthening the laminated stator body by increasing the diameter, is limited by the so-called track loading gage.

SUMMARY OF THE INVENTION

Accordingly, one object of the invention is to design a novel laminated stator body for a high-voltage turbogenerator of the type mentioned at the beginning in such a way that, with a comparatively small outside diameter of the laminated stator body and large slot depths for the stator winding, a sufficiently high mechanical strength in respect of operationally induced vibration amplitudes is achieved.

According to the invention, the object is achieved by the features of the first claim.

The advantages of the invention may be seen, inter alia, in the fact that, by virtue of the notches on the radial outside of the segmental laminations forming the laminated stator body, the natural frequency of the laminated body is considerably reduced and comes to lie below the rotational excitation frequency, whereas the magnetic conditions in the laminated body remain largely unaffected. The notches are not filled with a permeable material, as in the prior, art but are filled with air. Here, the notching permits a comparatively small diameter of the laminated stator body, which comprises the magnetic part of a high-voltage generator having deep slots for the conductor bars or conductor coils. It is especially advantageous if the notches end radially on the inside in a relief opening.

A first preferred embodiment of the invention is defined in that twice the number of notches as slots for the stator winding are arranged in the laminated stator body, the notch depth being in the order of magnitude of 20% of the yoke height.

A second preferred embodiment of the laminated stator body according to the invention is distinguished in that the number of slots and notches in the laminated stator body is the same, the notch depth being in the order of magnitude of 40% of the yoke height.

A width of the notches of about 0.5 mm to 1 mm is especially preferred.

BRIEF DESCRIPTION OF THE DRAWING

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing, wherein the single figure shows, in simplified representation, a preferred exemplary embodiment for the segmental laminations forming the laminated stator body according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing, wherein only the parts essential for the invention are shown and designated, a preferred exemplary embodiment of a segmental lamination 1 is shown in the figure, this segmental lamination 1 typically being provided on its radial inside with slots 2 for accommodating a stator winding (not shown here). A large number of such segmental laminations 1 are arranged next to one another in both the circumferential direction and the axial direction - that is, perpendicularly to the drawing plane - and form in their entirety a laminated stator body (likewise not shown). All the segmental laminations 1 are oriented in such a way that the slots 2 are arranged in alignment with one another.

According to the invention, the segmental laminations 1 are provided on their radial outside with a number of notches 3, which have a width K_B of between 0.5 mm and 1 mm and are arranged axially in alignment with one another. The notches 3 end radially on the inside in a so-called relief opening 4. The notches 3 are filled with air.

A laminated stator body, composed of the segmental laminations described, exhibits especially good mechanical properties in combination with optimum magnetic properties when used in a high-voltage generator, which is operated, for example, at operating voltages of 400 kV and above. For this purpose, as compared with conventional generators having operating voltages of 20 kV - 30 kV, a larger number of turns of a stator winding have to be inserted into a slot 2 having a

correspondingly greater depth N_T. As already discussed in the introduction, the yoke height J_H - that is, the dimension between the root of slot 2 and the outer radius r_a - must be correspondingly large for reliable operation under conventional mechanical vibration loading.

The invention now comes into play here, without the yoke height J_H having to be critically increased in view of the operationally induced vibrations. This would be a measure which is undesirable with regard to both the greatly increasing weight and an uneconomical transport size. The invention makes it possible, then, for the yoke height J_H to be designed essentially from magnetic aspects, that is, for a smaller yoke height J_H to be provided than would be necessary when considering the mechanical strength in operation.

A first typical numerical example will explain the invention in more detail:

If the laminated stator body of a high-voltage generator is designed only according to magnetic aspects, this results in a slot depth N_T of about 600 mm, a slot width N_B of 60 mm, a yoke height J_H of 500 mm, and a yoke outside diameter r_a of 3600 mm. Such a magnetically correct design, in a two-pole high-voltage generator of conventional type, would cause a 4-node vibration having an amplitude of about 150 µm at 95 Hz. In this case, the excitation frequency is 100 Hz. These operating values are inadmissible.

The arrangement according to the invention of radial notches 3 arranged so as to be periodically distributed over the outer circumference reduces the 4-node vibrations to an amplitude of about 50 m at 70 Hz. These values are noncritical under operating conditions. The number of notches 3 in this case is 72, which is twice as much as the number of slots 2. The notch depth K_T is in the order of magnitude of 100 mm, the notch depth K_T thus being in the order of magnitude of 20% of the yoke height J_H.

A second solution of the invention is shown in the following example:

At the same geometric dimensions of the outside diameter r_a, the slot depth N_T and the yoke height J_H, the same number of notches 3, distributed uniformly over the outer circumference, as the number of slots 2 produces an equally good reduction in the mechanical vibration loading, as described above, if the depth of the notches 3 is in the order of magnitude of 200 mm. In this case, the notch depth K_T is in the order of magnitude of 40% of the yoke height J_H.

Substantially deeper notches 3 than those shown in the two design variants cause the vibration amplitudes to increase again, on account of the increasing proportion of static deformation.

The function of the relief openings 4 is the same in the solutions shown according to the invention. Undesirable tearing-out in the root of the notches 3 under operationally induced vibration loading is thereby prevented.

The invention is of course not restricted to the exemplary embodiments shown. Thus, for example, another combination of the number of slots and the number of notches is also conceivable, in which case the notch depth must than also be adapted accordingly.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

WHAT IS CLAIMED AS NEW AND DESIRED TO BE SECURED BY LETTERS PATENT OF THE UNITED STATES IS:

1. A laminated stator body for an electrical machine, in particular a turbogenerator, which laminated stator body is composed of a multiplicity of segmental laminations (1), each segmental lamination (1) being provided on its radial inside with slots (2) for accommodating conductor bars or conductor coils of a stator winding, wherein each segmental lamination (1) is provided on its radial outside with periodically distributed notches (3), the notches (3) of axially adjacent segmental laminations in the laminated stator body being arranged in alignment with one another.

2. The laminated stator body as claimed in claim 1, wherein the notches (3) end in a relief opening (4) at their radially inner end.

3. The laminated stator body as claimed in claim 1 or 2, wherein the number of notches (3) is twice as great as the number of slots (2).

4. The laminated stator body as claimed in claim 3, wherein the notch depth K_T is in the order of magnitude of 20% of the yoke height J_H.

5. The laminated stator body as claimed in claim 1 or 2, wherein the number of notches (3) is equal to the number of slots (2).

6. The laminated stator body as claimed in claim 5, wherein the notch depth K_T is in the order of magnitude of 40% of the yoke height J_H.

7. The laminated stator body as claimed in one of the preceding claims, wherein the notches (3) have a width of between 0.5 mm and 1 mm.

ABSTRACT OF THE DISCLOSURE

In a high-voltage generator, notches (3) leading radially inward are provided in each segmental lamination (1) on the radial outside of the laminated stator body and end in a relief opening. The notches (3) cause the amplitude and the frequency of, for example, a 4-node vibration occuring during operation to be limited to noncritical values, although the laminated body is undersized mechanically with regard to its yoke height (J_H).

(Fig.)

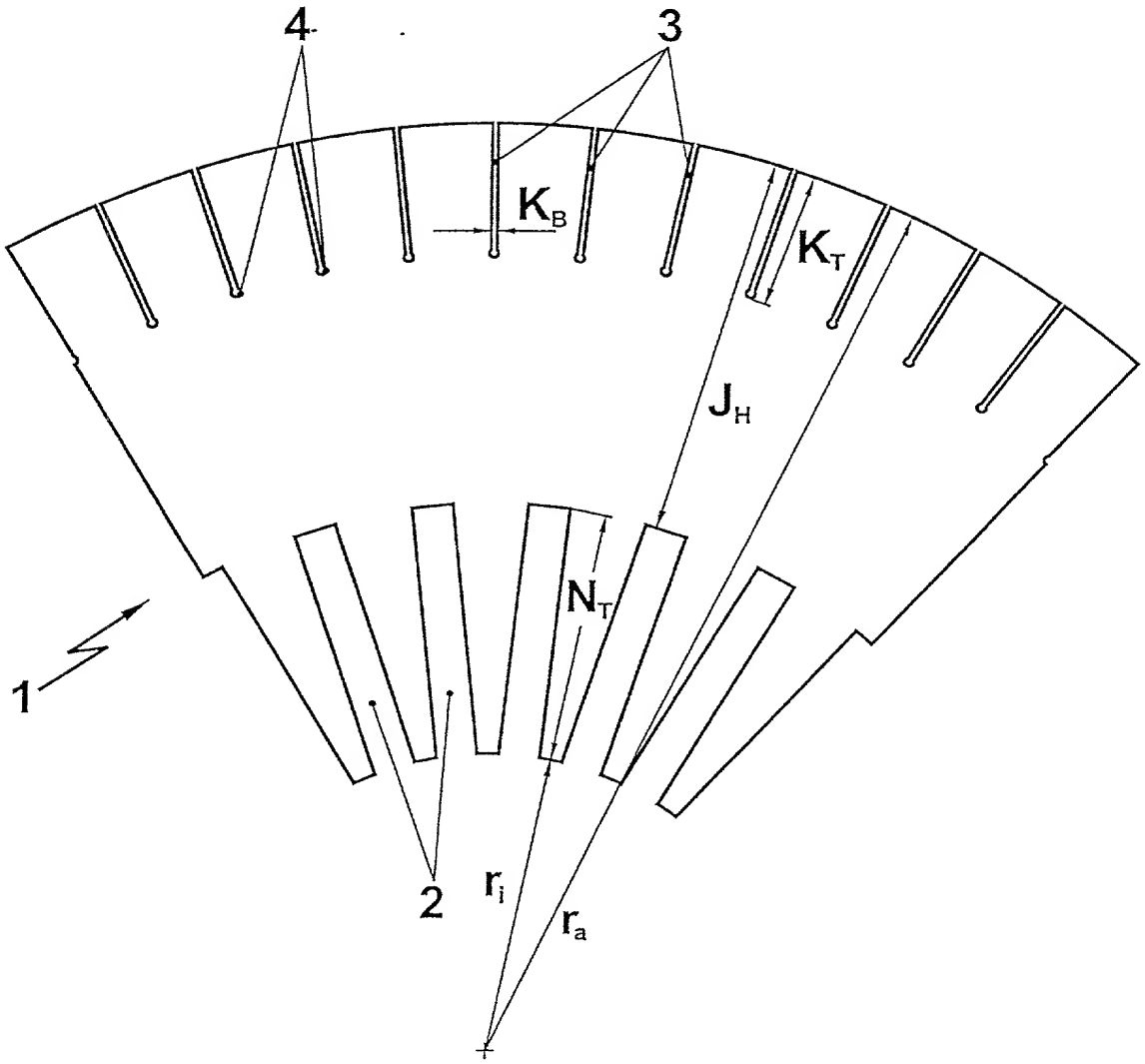

FIG. 1